

Kentucky Space Grant Consortium  
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## PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Kentucky Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2012.

## PROGRAM GOALS

The NASA Kentucky Space Grant (NKSG) goals are to serve the needs and emphases of NASA's National Space Grant College and Fellowship Program while serving the specific needs of the Commonwealth of Kentucky, through a program that enhances capabilities for aeronautics- and space-related research and education in Kentucky, and develops future workforce for NASA, Kentucky, and the nation. Therefore, NASA Kentucky Space Grant strives to promote a strong STEM education base by preparing students and teachers; to maintain a network of universities contributing to aeronautics and space; to encourage collaborations among universities, aerospace industry, and government; to support aerospace training, research, and public outreach; and to recruit and train U.S. citizens, especially women, minorities, and disabled persons. Kentucky Strategic Themes and Kentucky Emphases compliment NASA Educational Outcome Objectives and NASA Emphases while guiding definition of the 2010-2014 NKSG programs.

*NKSG Strategic Theme #1: Pathways of Opportunities* – Programs build on Kentucky's space science specialization, starting immediately and spanning the full five years of the plan to: 1) Provide integrated progressions of opportunities for STEM workforce development to meet NASA priorities, 2) Mirror NASA's Education Framework to Inspire, Engage, Educate, Employ, 3) Incorporate recognized local scientific sites (planetaria and observatories) as statewide outposts for teacher training, student internships, diversity engagement, and KSGC Affiliate leadership and involvement, 4) Be

a catalyst for higher education recruitment, and 5) Enhance in-state employment in Kentucky's aerospace industry.

*NKSG Strategic Theme #2: NextGen Partnerships* - Programs were developed early in the 5-year cycle then phased-in to provide: 1) A new in-state aerospace engineering degree option, 2) An emphasis on aeronautics R&D, 3) New links to the Kentucky Community and Technical College System (KCTCS), and 4) A new high-school-to-higher-education pathway combining aviation and aerospace supporting NASA's NextGen Air Transport initiative.

To achieve these goals, SMART objectives were defined in the FY 2010 proposal and revised in February 2013 with the Mid-Course Assessment. SMART objectives were revised to focus on measurable targets for students, awards, diversity, and institutional involvement and to move long-term indicators to become gauges of systemic change. Revised objectives and other actions resulting from the Mid-Course Assessment are indicated below (\*).

### PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

**Outcome 1:** Kentucky Space Grant Consortium provided funding through our Fellowship & Scholarship program to support USLI 2013 teams from the University of Louisville (UL) and Western Kentucky University (WKU). The UL team is comprised of undergraduate, masters, and doctoral students in multiple engineering fields who have used this experience to build disciplinary and cross-disciplinary capability as well as skill in project management, design, budgeting, teamwork, and communications to complement their careers. The team has done exceptional work building upon successes from their first year of competition in 2012, expanding to 16 students, and conducting fundraising campaigns using the website Kickstarter to contribute additional funds to their project. Their website (uoflusli.com) provides up-to-date communication of progress and accomplishments, including efforts to achieve an outreach goal of hands-on programs to over 1,000 students. The team captain, Nick Greco, applied, was selected and has signed on as a NASA intern at MSFC for Summer 2013.

**Outcome 1:** The Exomedicine Institute is an independent, nonprofit R&D endeavor initiated by Kentucky Space (KS) LLC with Higher Education Program support from the Kentucky Space Grant Consortium. Exomedicine Institute seeks to acquire a better understanding of the influences of microgravity on the dynamics of living systems, and to rigorously apply these insights to the advancement of current medical solutions. Kentucky Space involvement with microgravity research began with commercial partners and development of two research platforms now permanently installed on ISS and continues via a Space Act Agreement which allows KS the ability to integrate payloads onto launch vehicles to the ISS as well as provide access to research facilities aboard the ISS. KS also has signed an agreement with the J. Craig Venter Institute to deliver used ISS HEPA filters for genomic research. Kentucky Space enabled researchers at the University of Kentucky and Morehead State University to conduct preliminary experiments under a simulated near microgravity condition; the first Exomedicine

payloads were conducted on STS-134 and STS-135 which looked at the effect of the microgravity/space environment on Glioblastoma cancer cells. Currently the Exomedicine Institute has commissioned a series of white papers from leading researchers (most without a space science background) on the potential that microgravity provides as exomedicine strives to look at problems from different viewpoints and to open new avenues for commercialization. Initial experiments to be designed and flown to the ISS in 2013 and beyond will be based on the recommendations made in the following diverse areas: Regenerative Medicine, Protein Crystallization, Cystic Fibrosis, Oncology, Diabetes, Neurodegenerative Disease and Infectious Disease. Also, Kentucky Space has worked to expand its role on ISS by developing an EXPRESS Rack Locker payload which will allow for remote, high throughput, and iterative biological research aboard the space station. To date, IP issues have been settled and final design is imminent. Kentucky Space will take the payload through the verification process at Marshall Space Flight Center for use on both the SpaceX Dragon and Orbital Science Cygnus capsules.

**Outcomes 1, 2 and 3:** The Kentucky Institute for Aerospace Education (KIAE) is supported in the NextGen Partnerships initiative of the Higher Education program, as a bridging program from Kentucky's high schools to its higher education institutions that offer training in flight (EKU), maintenance (CC), business (various), and engineering (UK and UL). KIAE is a nonprofit organization that guides a network of participating high schools and develops teachers and students with interests in aviation and engineering careers. KIAE national partners include Aircraft Owners and Pilots Association (AOPA), Build-a-Plane, and Real World Design Challenge (RWDC), among others. KIAE growth since its inception in 2010-2011, along with student retention and improvement, commend this as a model for national adoption. Both the number of schools and the number of students at each school are increasing significantly (schools/students): Year 1 – 11/200; Year 2 – 13/300; Year 3 – 15/425; Year 4 – 19/NA. Each year NKSG sponsors the annual KIAE Wing Design Competition (WDC) developed by early-career faculty and students at the University of Kentucky. Participating teams design and build aircraft wings as a group project then meet for flight test and competition installing their wings on a standard-body model aircraft. The competition was moved this year to Lake Cumberland Regional Airport in Somerset, KY to accommodate a larger number of team participants, a larger crowd of the general public, as well as first-time participation from Somerset Community College Aviation Maintenance Technology program assisting with the event.

### PROGRAM ACCOMPLISHMENTS – Year 3

Program accomplishments refer to goals defined in the 2010 KY proposal and to SMART objectives revised in the 2012 KY mid-course review. Revised objectives and other actions resulting from the Mid-Course Assessment are indicated with asterisks (\*). Diversity accomplishments are presented as program contributions to NASA Education Performance Measures under MSI Collaborations and NASA Priorities – Diversity, as well as under Improvements Made in the Past Year.

**Outcome 1: Fellowship/Scholarship, Higher Education and Research Infrastructure**

Graduate Fellowships (GF): \*Revised objectives include funding 4 GF F/S per year, with 1 publication/presentation per fellow. Targets met – 5 graduate fellows; 6 publications/presentations.

Undergraduate Scholarships (US): \*Revised objectives include funding 3 US F/S per year. Target met – 4 undergraduate scholars.

NASA Academy/Interns, Outpost and NextGen Industry Interns (Interns): \*Revised objectives include funding 5 F/S Interns per year. Target to be met – 3 interns (two female, one disabled) placed at Johnson (1) and Goddard (2), NASA selection process still underway.

Team Projects (TP): \*Revised objectives include funding 1 F/S TP per year. Target met – 5 team projects including NASA USLI (2), NextGen aeronautics (1), CubeSat (1) and robotics (1).

Travel Scholars: \*Revised objectives include funding 4 F/S travel scholars per year. Target met – 4 students from Murray State University (2) and UK (2) attended the SG Southeast Region/MFSC Student Space Hardware Club Workshop in Huntsville, AL, Feb 2013.

Research Infrastructure Development Research Initiation Awards (RIA): \*Revised objectives include funding 2 total longitudinally tracked (LT) students under 5 RIA per year, with 2 publication/presentations per PI. Targets met – 5 RIA awards; 23 publications/presentations; 2 LT students.

Higher Education, Kentucky Space and NextGen partners: \*Revised objectives include funding 6 total longitudinally tracked (LT) students, involving 4 HE institutions and developing one new industry contact per year. Targets met – 8 LT students in addition to ones above (26 total); 4 HE institutions; new partnership established with Lockheed-Martin in Winchester KY including educational exchange, artifacts for display.

Curriculum Development/Revision (CDR): \*Revised objectives include supporting development/revision 1 course per year. Target met – 2 CDR awards.

**Outcome 2: Precollege Education**

Precollege education events: \*Revised objectives include 2,000 PSP per year. Target met – Engineer's Day Open House (440), WDC (est. 250), KSU event (50-100), UAV and SSL lab tours (1,350).

Mini-grants (MG): \*Revised objectives include supporting 6 MG awards per year (\* 2 in Year 3 due to reallocation to increase TP award numbers). Target met – 2 MG awards.

New outpost contacts: \*Revised objectives include new contact with one site per year. Target met – Program Coordinator developed mini-grant program summary and started contacting museums/planetaria/observatories to communicate upcoming Year 4 opportunities.

New NextGen partner contacts: \*Revised objectives include new contact with one new partner per year. Target met – 2 new contacts: Somerset Community College A&P Maintenance program; meeting scheduled for 18 April with ProxDynamics.

### **Outcome 3: Informal Education**

Informal Education Events/Partnerships: \*Revised objectives include supporting/participating in 3 informal education events per year: Target met – Engineers Day Open House, Campus Recruitment tour stop, Wing Design Competition open to the public, Women’s STEM Collaborative conference keynote speaker, among others.

## **PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES**

- **Student Data and Longitudinal Tracking:** Total awards = 26; Fellowship/Scholarship = 13, Higher Education/Research Infrastructure = 13; 2 of the 13 F/S awards represent underrepresented minority funding (3 of the 26 total awards represent underrepresented minority funding). During the FY12 program year 15 students are pursuing advanced degrees in STEM disciplines, 1 accepted a STEM position at a NASA contractor, 7 accepted STEM positions in industry, 2 accepted STEM positions in academia, and 1 went on to a position in a non-STEM discipline. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.
- **Minority-Serving Institution Collaborations:** MSI collaborations in 2012-2013 engaged administrators, faculty and students at Kentucky State University (KSU), the jurisdiction’s only MSI (an HBCU) with an enrollment of 2,200 degree-seeking students.

The NASA Kentucky Space Grant Directors and Program Coordinator met with Provost Dr. Joel Thierstein and computer science faculty Dr. Jens Hannemann on Monday, February 18<sup>th</sup> at Kentucky State University. Included were a presentation to introduce NASA Kentucky Space Grant and EPSCoR programs as well as a discussion of current KSU challenges and opportunities. A NASA Kentucky event was planned to educate and engage KSU students and faculty.

The NASA Kentucky KSU Event was held Wednesday, March 6<sup>th</sup> from 10 am to 2 pm in partnership with the KSU Department of Computer Science. Despite a delayed start due to snow and ice, most scheduled presenters were able to attend and interact with KSU students, staff and faculty about NASA and NASA Kentucky programs, including OSSI summer internships, Space Grant opportunities and EPSCoR research programs. About 50 KSU students (most minority and approximately half female) stopped at the event which was held in a high-visibility atrium area next to the campus cafeteria.

Two female students completed OSSI applications following the event, but to date have not been placed for Summer 2013. Two KSU faculty learned of collaboration and funding opportunities from interaction with presenters. One female faculty member in Computer Science is now a co-PI on the 2013 NASA EPSCoR proposal in development, bringing important GPU-computing expertise to the team. Another KSU faculty member applied for and was awarded the NASA EPSCoR faculty travel opportunity to visit a NASA Center. A third, Dr. Jens Hannemann who helped coordinate the KSU event and provost meeting, is mentoring student interns who will use game programming skills to develop small satellite simulations.

\* Note that these KSU initiatives were planned and conducted as part of the Mid-Course Assessment. Positive engagement of numerous Kentucky State University faculty, students and administrators with NASA and NASA Kentucky programs has resulted from the efforts leading to several new collaborations. Communication and engagement in the August 2013 NKSG RFP for 2013-2014 opportunities will be a continuing focus.

- **NASA Education Priorities:**

In 2012-2013, Kentucky SGC funded or hosted 26 projects/initiatives under the F/S, Higher Ed and Pre-College programs (excluding NASA Center summer interns). These projects and initiatives addressed both NKSG strategic themes: Space Science pathways and NextGen partnerships. These 26 projects/initiatives aligned with the 8 NASA Education priorities as follows:

- Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

20 of the 26 projects provide authentic hands-on experiences to higher-education students and to pre-college students and teachers through team projects (5), graduate fellowships (5), undergraduate scholarships (4), research initiation awards (3), mini-grants (1) and higher education initiatives (2). Projects range from student teams competing in the NASA USLI to NASA-infused STEM afterschool programming for at-risk middle-schoolers to exoplanet astronomy to a space engineering workshop for high school girls.

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

15 of 26 projects expand diversity participation in Kentucky, including 6 involving female faculty or students, 8 of 26 projects or initiatives involving regional/comprehensive and community college institutions, and 1 initiative involving an MSI institution.

9 of 26 total longitudinally-tracked (LT) students are female for 34.6% female participation. 3 of 26 LT students are minority for 11.5% minority participation. \*Revised Mid-Course objectives include funding 3 LT minority students, 12.2% NCES minority participation, 30% student female participation (Year-3) and conducting one MSI recruiting event. Targets met or exceeded (NCES target met within +/- 2%).

Institutional diversity is measured as the number of higher education institution (HEI) affiliates participating in the consortium programs. The objective is 8 HEI. Target met – >8 different HEI affiliates participated in reviews/attended consortium meetings; 7 different HEI affiliates had PIs submitting proposals; 6 different HEI affiliates had PIs receiving awards.

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

1 of the 26 projects directly engages pre-service teachers and middle-school students with NASA materials (REAL curriculum) adding a STEM component to an after-school program for at-risk middle-school students.

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

2 of 26 projects provide summer opportunities for secondary students on college campuses: 1) a space engineering workshop for high school girls at Morehead State University and 2) the Kentucky Institute for Aerospace Education (KIAE) family flight day at Eastern Kentucky University.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

NKSG provides support for the Kentucky Institute for Aerospace Education (KIAE), a non-profit network of high school programs offering aviation education to students interested in NextGen careers as pilots, as airport managers, in maintenance or in aerospace engineering, and for the annual Wing Design Competition (WDC) developed by the UK College of Engineering. Somerset Community College offers a leading training program in aircraft maintenance serving Kentucky industries including commercial airlines, Humana and UPS, among others. Through their partnership with KIAE and with the adjacent site of the 2013 WDC, a new relationship is being established with Somerset Community College (A&P technical school) as they participate in management of the competition, give tours of their operations, and provide insight into aviation maintenance education and opportunities for interested students and the public.

- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).

3 of 26 projects involve research in aeronautics, connecting faculty at three university sites across Kentucky to NASA researchers at Ames, Glenn, Langley and Dryden.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

None of the 2012-2013 (Year 3) new projects aligned with this priority. However, several projects in 2011-2012 were directly related to global climate change with at least one extended into Year 3 as efforts were completed.

- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

14 of 26 projects involve early-career faculty in research initiation awards building NASA partnerships and preliminary research results, mentoring graduate students, mentoring undergraduate research and developing curriculum materials.

## IMPROVEMENTS MADE IN THE PAST YEAR

Improvements made in Year-3 include adding a full-time Program Coordinator, Jacob Owen, who joined us from NASA Wallops in February 2013. He brings expertise in

communications and data management, along with NASA insight. Contact with students and affiliates has improved with Twitter and expanded use of other media.

Three new events were developed: 1) an introduction to NASA and NASA Kentucky programs at Kentucky State University (MSI and HBCU) can serve as a model for others at new or current (inactive) academic affiliates, 2) a public-venue Wing Design Competition (May) and 3) a strategic planning retreat for consortium affiliates (May). In Year-3, 8 different higher education institution affiliates participated in consortium meetings/reviews, with PIs from 7 different institutions submitting proposals and from 6 different institutions selected for awards. \*Expanded communications and MSI collaborations were part of the Mid-Course Assessment plan which also included revisions to SMART objectives and elimination of matching for our MG and US programs to enable more regional affiliate participation.

Improvements were seen in diversity participation of students. 9 of 26 total longitudinally-tracked (LT) students are female for 34.6% female participation. 3 of 26 LT students are minority for 11.5% minority participation. \*Revised Mid-Course objectives include funding 3 LT minority students, 12.2% NCES minority participation, 30% student female participation (Year-3) and conducting one MSI recruiting event. Targets met or exceeded (NCES target met within +/- 2%).

Positive engagement of numerous Kentucky State University faculty, students and administrators with NASA and NASA Kentucky programs has resulted from the efforts leading to several new collaborations. \*Note that these KSU initiatives were planned and conducted as part of the Mid-Course Assessment. Communication and engagement in the August 2013 NKSG RFP for 2013-2014 opportunities will be a continuing focus.

## PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Bellarmino University	Private, Parochial University
Centre College	Private College
Eastern Kentucky University	Public Comprehensive University
Kentucky Science and Technology Corp.	Non-profit Organization
Kentucky State University	Public Comprehensive University, HBCU
Morehead State University	Public Comprehensive University
Murray State University	Public Comprehensive University
Northern Kentucky University	Public Comprehensive University
Thomas More College	Private, Parochial College
Transylvania University	Private University
Tribo Flow Separations, LLC	Industry
University of Kentucky	Public Doctoral Granting University
University of Louisville	Public Doctoral Granting University
Western Kentucky University	Public Comprehensive University
Kentucky Institute for Aerospace Education	Non-Profit Organization

Affiliate Representatives attend bi-annual consortium meetings, distribute Requests for Proposals, encourage proposal submissions, promote partnerships with NASA, participate in proposal review cycles, conduct/attend NKSG events/initiatives and develop program consortium membership and policies. Affiliate reps also attend a consortium meeting scheduled as part of the annual Kentucky EPSCoR conference where NASA Kentucky Space Grant and EPSCoR projects are presented to leaders and attendees from Kentucky government, industry and academia. In 2013, the conference will held on October 17<sup>th</sup>.

An all-day meeting of the affiliate representatives is scheduled for May 20, 2013 at which a comprehensive strategic planning effort and policy revisions will be completed (e.g., approving changes to program funding allocations as well as revising required program matching in the annual NKSG RFP). \*Note that original 50% (\$0.5:\$1) matching requirements on undergraduate scholarship and mini-grant programs was based on the need for faculty release time assignment at regional/comprehensive universities. Now, however, recent institutional policy changes at regional/comprehensive institutions preclude participation in previously popular programs supporting undergraduate participation. This has been attributed in part to university administrations being unwilling or unable to allow proposals to programs requiring faculty matching.

**The National Space Grant Office requires two annual reports, this Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**